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AUTHOR Bishop, John
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ABSTRACT

A model for estimating the effect of public policies on the demand for higher education is presented, with attention focused on the influences of public policy and the economic environment, and the interaction of these factors with student ability and parental income. Policy instruments are tuition, admissions requirements, location of different kinds of colleges, and draft deferments. The following economic and social environmental factors are indirectly influenced by government: the social status of the student's neighborhood, the opportunity cost of the student's study time, and the size of the anticipated earnings payoff to college graduation. A binominal logit model was fitted to the college attendance behavior of 27,046 male high school juniors, divided into 20 subgroups defined by student ability and family income, in 1960. Tuition, high admission standards travel costs, and room and board costs had significant negative effects on attendance. The highest elasticities of demand were found for the low-income strata and lower-middle ability quartile. suggesting that an efficient subsidy program should focus on these groups. The powerful impacts of public policy measures and draft pressure suggest that the Vietnam War and public policy shifts that lowered the real cost of college attendance contributed to the high growth rate of college attendance in the 1950s and 1960s. The policies that contributed to this growth were increased student aid, liberalized admission requirements, and the establishment of new community colleges and public universities in previously unserved areas. (SW)

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THE EFFECT OF PUBLIC POLICIES ON THE DEMAND FOR HIGHER EDUCATION

John Bishop

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ABSTRACT

A binominal logit model is fitted to the college attendance behavior of 27,046 male, high school juniors in 1960, divided into 20 subgroups defined by student ability and family income. Tuition, high admissions standards, travel costs, and room and board costs all have significant negative effects on attendance. The highest elasticities of demand are found to occur in the low-income strata and lower-middle ability quartile, suggesting that an efficient subsidy program should focus on these groups. Coefficients on foregone earnings and measures of the local payoff to college attendance were small but generally had the expected sign.

The powerful impacts of public policy measures and draft pressure suggest that the Vietnam War and public policy shifts that lowered the real cost of college attendance contributed to the high growth rate of college attendance in the fifties and sixties. The policies that contributed to this growth were increased student aid, liberalized admission requirements, and the establishment of new community colleges and public universities in cities and states that had none before. The recent decline in male enrollment rate is therefore, not solely due to the reduced payoff to college. It also reflects the end of the draft and the fact that by 1970 all of the major cities had local public colleges.

THE EFFECT OF PUBLIC POLICIES ON THE DEMAND FOR HIGHER EDUCATION

Despite the fact that more equal access to higher education has been an objective public policy for over a decade, little is known about the effectiveness of alternative means of achieving this goal. Econometric work has established that college attendance is positively associated with parental education, family income, and student ability, and negatively related to tuition [Campbell and Siegel, 1967; Hopkins, 1974]. It has been suggested that youth from low-income backgrounds have higher elasticities of demand, and a number of studies have obtained results that are consistent with this hypothesis [Corazzini et al., 1972; Hoenack, 1971; Radner and Miller, 1970; Kohn et al,, 1974]. Little is known, however, about the impact of admissions policy, college location or curriculum, draft pressure, or the economic environment on college entrance decisions. Nothing is known about the relative effectiveness of alternative policy measures on different ability groups.

This paper will attempt to fill these gaps in the literature by estimating a model of college entrance that focuses on the influences of public policy and the economic environment, and the interaction of these factors with student ability and parental income. The policy instruments examined are tuition, admissions requirements, location of different kinds of colleges, and draft deferments. The aspects of the economic and social environment indirectly influenced by government that are examined are the social status of the student's neighborhood, the opportunity cost of the student's study time, and the size of the anticipated earnings payoff to college graduation.

A binomial logit model is fitted by maximum likelihood to the behavior of 27,046 male high-school juniors in 1960, categorized by ability quartiles and by five family-income strata.

For estimating response to price, the Project Talent data used here are better than any previously available. The study is longitudinal; we do not depend upon memory for measures of student ability or of high school location or character, and the dependent variable is actual attendance rather than plans to attend. The large sample size allows the estimati of separate models for different income/ability groups. It is national and thus has variation in that most critical variable, tuition. Even its age is an advantage. Only limited amounts of scholarship aid were available at public institutions in 1961 when our sample was graduating from high school, so the difficulty of satisfactorily modeling the scholarship awarding process does not create serious problems. There are problems with the response rate for the Project Talent Sample, however; these problems and how they are handled are discussed in the Appendix.

Tuition, high admission standards, foregone earnings and travel, and room and board costs are found to have a significant negative effect on attendance. The per dollar effect of tuition is larger than any other cost and is largest of all for low-income, middle-ability students. Cross-sectional measures of the expected payoff to college have a negligible relationship with attendance. The powerful impacts of public policy measures and draft pressure suggest that the rise in college attendance rates in the fifties and sixties was partly due to the liberalization of admissions policies, the establishment of new community colleges and public four-year colleges in cities and states that had had none before, and the Vietnam War.

Section 1 presents the theoretical underpinnings of the estimating equations and describes the variables used to predict college attendance. Section 2 presents the results and develops some of their policy implications. Section 3 uses the cross-sectional results to interpret recent trends in college enrollment and to question projections of substantial declines in enrollment rates.

1. THE COLLEGE ATTENDANCE DECISION

An individual will enter college if the expected utility from any of the feasible college alternatives is greater than the utility of the best noncollege alternative. If unlimited borrowing were possible at a given interest rate and there were no debt aversion, lifetime utility maximization would imply college attendance when, discounted at this interest rate, the present value of benefits (both pecuniary and nonpecuniary) exceeds the pecuniary and nonpecuniary costs of attendance. Since the students in our sample could not borrow thousands of dollars at fixed interest rates, implementing a desire to attend college required, as well, an ability to finance the out-of-pocket costs.[1] The sum of resources available--savings, summer and part-time earnings, gifts, and loans--must be greater than the total out-of-pocket costs. of attending college--tuition, travel, and all living costs.

A youth attends college if, relative to the best noncollege alternative, there is at least one college that is simultaneously desired and possible to finance. Only one college meeting these requirements is necessary. It is not, therefore, the average tuition, selectivity, and proximity of the colleges in a particular jurisdiction that should enter our model,

but rather the characteristics of the "most attractive" college. Determining which college is most attractive, however, is not easy. While for each individual it is possible to rank colleges unambiguously on any one criterion, both preferences and colleges are multifaceted and it is not clear what relative weight should be given each facet. Measures of many important facets--academic quality, climate, religious orientation--are not available.

Our solution to this problem is to determine a set of colleges that are expected to be feasible for the student to attend (see the Appendix for details) and then to assume that the relevant choice is between the cheapest of those feasible colleges and not attending college at all. The costs of attendance considered are tuition, travel, and incremental costs of room and board, with the minimum-cost college being determined mainly by tuition and travel costs..

Finding the minimum-cost college involved comparing modes of attendance--commuting versus living on campus--as well as colleges. The marginal cost of commuting was the sum of the out-of-pocket transportation costs ($9.60 per mile per year) plus time costs (which fluctuate with the local wage level around a mean of $7.20 per mile per year).[2] The cost of living on campus was defined as room and board charges plus $205 for travel and laundry minus an estimate of savings of costs at home (which fluctuated around a mean of $285 according to local variations in the price of food). Valued this way, commuting was always cheaper when a public college was within twenty miles. In states with high room and board charges the cutoff point often went as high as thirty-five miles. The premiums for out-of-state tuition and the rise of travel cost with greater distance meant that the minimum-cost college was typically a public college in the

student's home state, and more often than not a local one. The tuition charged by this college was in most cases identical to the charges at other public colleges in that state.

Implications of the Planned Nature of College

Since college requires financial and academic preparation, most families make general college plans many years in advance of high school graduation. When asked about whether and when they were going to college, only 12 percent of ninth-grade boys in 1960 answered, "I may go to college sometime in the future, but my plans are not definite" [Flanagan et al., 1964, p. E-13].

Advance planning affected the empirical specification of our model of college attendance. The family's financial capacity should be measured by permanent income, not current income, and college availability variables should reflect the environment prior to, as well as at the time of, high school graduation. Public policies such as tuition level and admissions selectivity influence decisions made early in high school: whether an academic curriculum is chosen, how much time is devoted to study, and how much parents encourage college as a goal. These decisions, in turn, affect the student's grades in high school and performance on achievement tests and, thus, admissibility to various types of colleges. Regressions run on this data to predict grades, test scores, and the academic orientation of courses support these hypotheses. Consequently, part of the influence of low tuition on college attendance is mediated by (operates through) test scores and grades, and using these variables as controls would bias downward our estimate of the total effect of tuition. Our stratification on and control for ability is, therefore, based on an academic

aptitude composite purged as much as possible of subtests that reflect a college preparatory curriculum.[3]

The endogeneity of a student's high school credentials has further implications. The set of prices for college that a student faces upon graduation depends partly upon his performance in high school. Better credentials mean a student can get into more schools and is more likely to be awarded scholarships. Consequently, the price (the cost of the cheapest method of attending a college of given quality) is lowered. However, since performance in high school is influenced by expected college availability, making the set of relevant colleges a function of the student's credentials would result in tuition simultaneously being a cause and a consequence of college plans. We chose to finesse this problem.[4] Each student's set of feasible colleges was not made a function of his ability, and no attempt was made to measure scholarship availability. The effect of admissions standards on college entrance was picked up by our measure of the proportion of the state's high school graduates admissible at the minimum-cost college.

We were estimating, therefore, a reduced-form model that encompassed both the student's behavior--choice of curriculum, effort in high school, applications to and choice of colleges--and the college's admissions decision.[5]

The reduced form model that will be fitted by maximum likelihood to the college attendance behavior of 27,046 young men is

$$\log [P_i/(1-P_i)] = \theta_o + \theta_1 X_{i1} \ldots \theta_n X_{in} + u$$

where P_i = the probability that the "i" th individual attends college within two years of being first sampled in the spring of his junior year in high school.

X_1 = total costs (tuition + travel + room + board - savings at home) at the cheapest feasible college in hundreds of dollars deflated for the local cost of living. $\bar{X}_1$ = 4.25. $\theta < 0$.

X_2 = tuition at the cheapest feasible college in hundreds of dollars deflated for the local cost of living. $\bar{X}_2$ = 2.25. The coefficient on tuition is expected to be negative because a) tuition is measured more accurately than the other components of minimum cost, b) the other public colleges of the state typically have the same tuition, c) tuition may have unique psychological effects on the student's planning The total effect of tuition on attendance is given by the sum of θ_1 and θ_2. It is, therefore, also hypothesized that $\theta_1 + \theta_2 < 0$.

X_3 = the proportion of the states' high school graduating class that is admissible at the cheapest feasible college. The effect of this variable is constrained to be zero in the highest ability quartile. It is expected to be positive in the other ability quartiles. $\bar{X}_3$ = .75.

X_4 = one of the cheapest feasible college is a two-year extension campus of a four-year university without terminal vocational programs; and zero if the cheapest feasible college is either a four-year college or a two-year institution with terminal vocational programs. The variety of program offerings is much smaller on extension campuses, so we expect θ_4 to be less than 0. $\bar{X}_4$ = .19.

X_5 = the additional cost of attending the cheapest four-year college over the cost of the cheapest feasible college of any type in hundreds of dollars deflated for the local cost of living. For the 42 percent of the sample where a four-year college is the cheapest feasible college of any type, $X_5 = 0$. $\bar{X}_5 = 1.9$.

X_6 = social status of the neighborhood. It is expected to have a positive coefficient because the aspirations of a student's peers and the quality of the high school are a function of a community's status and resources. It was defined as the real median family income in hundreds of dollars in the three middle-income groups and median years of education of adults over 25 measured in tenths of years of schooling in the poverty and high-income strata. The standard deviation of both measures is 14.6. The neighborhood is defined as the census tracts immediately surrounding the high school in big cities, the town or village in suburbs and small cities, and the rural part of the county in communities with populations smaller than 2500.

X_7 = foregone earnings and is defined as one-third of the median yearly earnings of male operatives in the SMSA or county of residence deflated for the local cost of living. Using 1300 hours as the estimate of study time and taking account of the lower wage rates received for part-time and summer jobs, the ratio of before tax foregone earnings to yearly earnings of operatives is .41. The cost of lost work time is the after-tax wage rate. Applying a marginal tax rate of .20 reduces the ratio to .33. $\bar{X}_7$ = \$1448 or \$1.11 per hour

σ_7 = \$268 or \$0.21 per hour. There is not a priori expectation for the sign of θ_7.

X_8 = the earnings differential between college and noncollege occupations and is measured in hundreds of 1959 dollars deflated for the cost of living. From an average of the median earnings of male secondary school teachers, accountants, and electrical and mechanical engineers was subtracted the median earnings of operatives. The local labor market is either the SMSA of residence or the non-SMSA portion of the state. $\bar{X}_8 = 29.5$ and $\sigma_{X_8} = 5.7$. θ_8 should be positive because higher monetary returns to college should attract more students.

X_9 = draft pressure and is one hundred times the ratio of induction and preinduction physicals passed in fiscal years 1960 and 1961 to the stock of nonfathers under age 26 who were or would have been classified I-A, I-A0, I-S, or II-S. The proportion of all registrants who were classified varied from state to state because different states choose to start the classification process at different ages. It was assumed that all of the unclassified registrants would be classified eligible except fathers and that one-half of the married 19 to 20-year-old men were fathers. $\bar{X}_9 = 4.05$ and $\sigma_{X_9} = .817$. We hypothesize that avoiding or postponing the draft increases the incentive to attend college, so θ_9 should be positive.

X_{10} = Project Talents' academic aptitude composite minus the students score on the Math Information test. Hyp: $\theta_{10} > 0$.

X_{11} = Project Talents' Family Socioeconomic Status scale, based on student response to nine questions on parents' income, education, occupation, and the number of books, study aids, and consumer durables in the home. Hyp: $\theta_{11} > 0$.

X_{12} = number of siblings. $\bar{X}_{12} = 3.6$. Hyp: $\theta_{12} < 0$.

X_{13} = an index of the frequency and recentcy of school changes. Frequent changes may reflect an unstable home environment. A change of schools cannot help but disrupt the educational process and the more recent the change the greater will be the effect on college attendance. The coefficient on this variable is, therefore, expected to be negative.

This model was fitted separately to date for twenty groups of high school juniors, each group defined by ability and family income. Table 1 presents the weighted mean probability of entering college ($\bar{P}$) for each of these 20 groups.

A logit specification of a statistical model of the college attendance decision has been derived from choice theory by a number of authors [Bishop, 1976b; Kohn et al., 1974]. For the analysis of dichotomous choice, a logit specification has a number of advantages. a) Its coefficients are directly interpretable as measuring proportionate changes in the odds of an event. b) Its coefficients are easily translated into predicted changes in probability or elasticities. c) It has a computable likelihood function and is, therefore, easy to estimate in individual data. d) Most important of all the response curve to increases in a stimulus has the sigmoidal shape that dichotomous choice problems almost always

Table 1

Probability of Entering College by Income and Ability

Family Income	Ability Percentile 100-73	72-49	48-27	26-0	All Abilities
High	.842	.606	.405	.374	.624
High-middle	.752	.437	.357	.292	.488
Middle	.742	.423	.218	.194	.413
Low-middle	.664	.319	.168	.135	.299
Poverty	.561	.249	.118	.097	.191
All Incomes	.749	.418	.239	.191	.399

produce. In the past the most common method of analyzing dichotomous choice has been estimating linear probability functions using ordinary least squares. This approach, however, does not constrain a probability to the zero-one interval and suffers from heteroskedasticity when fitted to individual data. The probit specification is rejected because while it avoid the problems of the linear probability model, it is harder to compute than a logit and very difficult to interpret.

2. RESULTS

This rather parsimonious logit model proved quite successful in explaining college entrance behavior. For within-Strata models R^2 ranged between .38 and .067 and entropy reductions ranged between .211 and .034.[6] For predicting a zero-one variable in populations stratified on the two most important variables, this range is quite good. The entropy of the distribution before stratification was .6687. The average conditional entropy of our models is .4737. Thus the combined effect of stratifying by ability and income and the separate logit models is to reduce the uncertainty of a particular individual's choice by almost a third. The four background control variables (X_{10} . . . X_{13}) were almost always highly significant. The policy variables (X_2 . . . X_5) and the social and economic environment variables (X_6 . . . X_9) generally had the sign predicted a priori and were statistically significant in about half the strata. (A complete set of the estimated maximum likelihood parameters is available from the author on request.)

Table 2 presents the detailed results for the two most important policy instruments for controlling enrollment in higher education:

Table 2

Total Effect of $100 Increase in Cost on the Log Odds of Entrance (Change in Proportion Attending per $100

Tuition ($\theta_1+\theta_2$)	Ability Quartile				All Abilities			Marginal Subsidy Cost
Income	Top	Upper-Middle	Lower-Middle	Bottom	Coef.	Prob.	Elast.	
High	.019 (.002)	-.298†*(-.059)	-.195* (-.044)	.009† (.001)	-.104	(-.0219)	-.084	$3749
High-middle	-.329*†(-.048)	-.145* (-.029)	-.563†*(-.101)	-.159* (-.024)	-.287	(-.0479)	-.192	$1919
Middle	-.048* (-.004)	-.211†*(-.046)	-.418†*(-.061)	.072 (.009)	-.172	(-.0241)	-.117	$2614
Low-middle	-.204†*(-.036)	-.140†*(-.027)	-.330†*(-.042)	.033 (.004)	-.148	(-.0232)	-.155	$2189
Poverty	-.087† (-.018)	-.096 (-.016)	-.529†*(-.049)	-.651†*(-.048)	-.434	(-.0375	-.393	$1409
All incomes								
Coef.	-.115 (-.0188)	-.187 (-.0379)	-.391 (-.0563)	-.099 (-.0069)	-.198	(-.0256)		
Elast.	-.050	-.181	-.471	-.072	-.143			
Marginal Subsidy Cost	$4884	$2003	$1325	$3668	$2295			
Travel, Room, and Board								
High	.006 (.001)	-.025 (-.005)	-.186* (-.039)	.192 (0.28)	-.008	(-.0040)	-.013	
High-middle	-.105* (-.015)	-.103* (-.021)	.240 (.043)	-.269* (-.041)	-.069	(-.0105)	-.043	
Middle	-.126* (-.022)	-.095* (-.021)	-.007 (-.001)	.027 (.003)	-.054	(-.0106)	-.051	
Low-middle	-.106* (-.019)	-.031 (-.006)	-.196* (-.025)	-.009 (-.001)	-.081	(-.0118)	-.079	
Poverty	.140 (-.028)	..066 (.84)	-.147 (-.014)	-.197* (-.014)	-.087	(-.0036)	-.038	
Total Coeff. (Prob.)	-.072 (-.0119)	-.053 (-.0114)	-.074 (-.0096)	-.036 (-.0029)	-.059	(-.0089)		
Elast. at $200	-.032	-.055	-.080	-.030	-.045			

Table 2--Continued

Notes: *Coefficient of the cost component is significantly negative at the .05 level by a one tail test.

†Tuition significantly more negative than travel, room, and board at the .05 level.

Marginal Subsidy Cost = MC - MR = (MC-T) + (T-MR) = $9.00 + \bar{P}/(d\bar{P}/dX_1)$.

a) tuition and b) travel plus incremental room and board costs. For each income-ability strata we present estimated logit coefficients for and predictions of the change in the groups aggregate college entrance rate per $100 change in tuition. If one accepts the theory behind the logit specification, it is the logit coefficient that should be stable across studies, and with appropriate deflation for price or wage changes, should be stable over time. If the predicted probability of attendance ($\hat{P}_j$) is known for the "j"th individual, the elasticity of his probability of enrollment is given by $\eta = \theta_j \bar{X}_j (1-\hat{P}_i)$. For instance, a high-ability, lower-middle-income, student whose predicted probability of entrance is .3 has elasticity of .286[i.e., $.204 \cdot 2 \cdot (.7)$] if he faces a tuition of $200. As one moves down a logit demand curve there is a precipitous decline in the elasticity of demand. Cutting tuition in half will more than halve the elasticity of demand. An outward shift of a logit demand curve also lowers elasticities. This leads us to expect students with high income or high ability to have significantly lower elasticities of demand.[7]

The "i"th individual's change in probability of attendance per unit change in X_j is given by $d\hat{P}_i/dX_j = \hat{P}_i(1-\hat{P}_i)\theta_j$. Note that the probability multiplier ranges between 0 and .25 and is largest when the individual has a .5 probability of attending college. The student for whom the elasticity of demand was calculated earlier is predicted to experience a .043 = [i.e., .3(.7).204] decrease in his probability of attendance if tuition rises by $100.

The purpose of estimating our model of college entrance is to make predictions about response of groups to policy. The change in a group's attendance rate per unit change in X_j is obtained by calculating the change in probability for each member of the group and summing across the

whole group $d\bar{P}/dX_j = \sum_{i=1}^{N} \hat{P}_i(1-\hat{P}_i)\theta_j/N$. The change in a group's attendance rate is necessarily smaller (10 to 25 percent lower in our data set) than the change in the probability of attendance predicted for a person with mean characteristics (i.e., $\hat{P}_i = \bar{P}$).[8] Consequently, predicting the effect of a policy change on group behavior by evaluating logit coefficients at sample means will systematically overstate the expected impact.

Higher Education Policies

Tuition at the minimum-cost college had a major effect on college entrance. If as some have proposed, tuition were set at the full cost of instruction without compensating increases in grant aid, these equations predict that the college entrance rate would have been 19 percent rather than 40 percent in 1961. Such an impact seems large, but it is not inconsistent with other studies. The .0286 per $100 effect obtained is similar in magnitude to the .0243 obtained by Hopkins [1974] for 1963 enrollment rates.

In sixteen of the twenty subgroups tuition showed the predicted negative effect on college attendance. In fourteen of these subgroups this negative effect was statistically significant at the .05 level by a one-tail test. There appears to be an important nonlinear interaction between student ability and responsiveness to tuition, for the extremes of the ability distribution were the least responsive to the level of tuition. Three of the four positive tuition coefficients occurred in the bottom-ability quartile. No doubt many of these students believed themselves to be irreconcilably ineligible for admission to the minimum-cost college. For them the cost at this college was irrelevant. This explanation is supported by the very powerful effect that admissions policy

had on the college attendance of students in the three low-ability strata with positive tuition coefficients.

The impact of tuition on college attendance also varied with family income. Students from the high-income stratum were least responsive, and students from the low-income stratum were the most responsive. At the mean tuition of $200, the tuition elasticity of the high-income stratum is -.084; for the poverty stratum it is -.393. Tuition elasticity was powerfully and nonlinearly related to ability: The high-ability quartile's tuition elasticity was -.05, the lower-middle-ability quartile's elasticity was -.07.

These systematic variations in the elasticity of demand by ability and family income have some important policy implications. The marginal subsidy cost of an extra student is equal to the per-student subsidy of instructional cost plus the difference between the price paid and the marginal revenue.[9] The tabulation of marginal subsidy costs in Table 2 reveals that they are inversely correlated with tuition elasticity. If in 1961 a million dollars had been spent lowering the general level of tuition for new high school graduates and providing the staff to teach them, 436 new full-time students would have been produced. In the 1960s almost all scholarship aid went to students in the top-ability quartile. A million dollars spent in this way, however, resulted in only 209 extra students. Limiting eligibility to the bottom three income groups hardly changes the number of new students (from 209 to 215). The policy of aiding the able has been criticized on equity grounds [Denison 1974]. Our results indicate that if the objective of policy is simply "more students," aiding the able is also inefficient. By this criterion aiding students

from low-income families is even more efficient than general reductions in tuition. A million dollars made available to poverty students of all abilities would have produced 710 extra students in 1961.

Federal intervention into higher education financing seems to reflect this view of the relative effectiveness of alternative strategies for promoting attendance, for priority has been given to students as opposed to institutional aid and eligibility for Basic Opportunity Grants has been made a function of family income only.

Despite the difficulty of accurately measuring the costs of travel, room, and board, nine statistically significant negative coefficients are obtained (see the bottom panel of Table 2). Averaged over all subgroups, a $100 increase in these other costs lowered the attendance rate by .0089. The per-dollar effect of travel, room, and board averaged about 30 percent of tuition's impact. This was expected, because tuition was measured more accurately than other costs and may have a uniquely powerful psychological impact. The hypothesis that the per-dollar effect of travel, room, and board was less negative than tuition's per-dollar effect was accepted for twelve subgroups.

In Table 3 the results for the different variables are used to produce estimates of the effect of specific public policy decisions on entrance rates disaggregated by either ability quartile or income strata. Locating the minimum-cost college in the center of a city rather than in the outskirts lowers the average travel distance for everyone in a metropolitan area by about four miles. This reduces cost by $67 and the average attendance rate is predicted to increase by .006 (i.e., .65 x .0089). Establishing a new public four-year college in a city without one

Table 3

Changes in the Percent of a Community's High School Juniors Entering College That Resulting from Selected Changes in Public Policy or Environment

	Ability Quartiles					Family Income				
Percent Entering College	Total 40	High 75	HM 42	LM 24	Bot 19	High 62	HM 50	Mid 41	LM 30	Pov 19
Higher Education Policies										
1) College in center rather than outskirts of town with 6-mile radius[b]	.6*	.8*	.8*	.6*	.2	.3	.7*	.7*	.8*	.2
2) 4-year public college established in town with none before[a]	4.2*	5.6*	5.4*	4.5*	1.4	1.9	4.9*	5.0*	5.6*	1.7
3) Transforming an extension campus into a community college[a]	4.6*	2.2†	7.1*	.1	8.6*	5.7*	0.7*	3.0†	5.4*	10.8*
4) Tuition at all public colleges raised $200	-5.7*	-3.8*	-7.6*	-11.2*	-1.4†	-4.2*	-9.6*	-4.8*	-4.6*	-7.5*
5) Tuition at 4-year public colleges raised $200 while 2 year tuition remains constant[c]	-1.2*	-2.4*	-1.5*	-.5	-.2	+.8	-1.5†	-1.1†	-2.7*	-1.0
6) Open admissions replaces a 50 percent cutoff	3.8*	0	3.7*	5.0*	6.7*	5.0*	7.2*	2.6*	4.6*	-1.3
7) 2-year community college established in town with none before[a]	1.4	0	1.7	3.2	1.0	3.8	1.4	2.4	-.7	-.6
8) 2-year community college with open admissions in town with none before[d]	3.3	0	3.6	5.7	4.4	6.3	5.0	3.7	1.6	-1.3
9) California versus Indiana[e]	14.1	6.0	18.4	16.3	16.7	14.9	17.5	10.4	14.6	19.7

Table 3--Continued

Percent Entering College	Total 40	High 75	HM 42	LM 24	Bot 19	High 62	HM 50	Mid 41	LM 30	Pov 19
10) California versus Newark, New Jersey[f]	14.8	6.8	18.7	27.2	9.5	13.0	25.9	11.8	12.9	12.9
Cultural and Economic Environment										
11) Move to a neighborhood with $1000 higher mean family income	1.6*	.3	2.2*	1.0†	2.8*	1.2*	3.8*	2.3*	-.6	1.7*
12) Have a family with $1000 higher income[g]	2.7	2.5	2.5	3.2	2.7	-	-	-	-	-
13) In family with a standard deviation higher SES	8.0	10.1*	10.4*	1.8†	8.8*	7.2*	16.2*	6.5*	6.4*	5.6*
14) Foregone earnings higher by $200 (15¢ an hour)	-1.1*	-.3	-2.5*	.8	-2.3*	-2.6*	-1.6†	-1.4*	.2	-.5
15) Future earnings difference higher by $200 a year	.4*	-.2	1.0*	1.8*	-.6	-.3	-.3	.6*	.8*	1.0*
16) Draft pressure increased by one standard deviation[h]	1.5*	1.7*	.8	-.2	3.6*	3.2*	.7	2.7*	1.0	-1.8†

Notes: The hypothesis tests reported in this table are for the weighted average of the logit coefficients where the weights are those that produce the estimate of the change in proportion attending for a whole quartile or strata (i.e., for a combination of groups). $d\bar{P}/dX_1/\bar{\sigma}_1 = \Sigma w_{ij}\theta_{ij}/(\Sigma w_{ij}{}^2\sigma^2\theta_{ij})^{.5}$.

They are one tail for lines 1-6, 11, 13 and 15 and two tail for line 14 and 16. Lines 7-10 are not tested because they are combinations of coefficients. * indicates significance at .01 level. † indicates significance at the .05 level.

Table 3—Notes Continued

a) A community college is a locally controlled two-year institution and had vocational as well as transfer programs. Colleges established in the community were assumed to have the same tuition and admissions policy as other four-year institutions in the state unless specifically stated otherwise. A newly established local college was assumed to be on average four and one-half miles from its clientele and to be an alternative to a college with room and board charges of $600. The net savings was $471 so the tabulated effect on attendance equals 4.71 times $d(\bar{P}_i/dX_2)$ for the appropriate groups (i).

b) Average distance to college (using doubling for first three miles) went from 9.67 to 5.67, so R was reduced by $67. This assumed a constant density in the center (radius three miles) that was three times the ring's density and a uniform distribution of income and ability groups within the city.

c) Assumes the two-year college was the cheapest college both before and after the tuition change at the four-year college. Higher tuition in the last two years of a four-year college would also cause the tabulated enrollment effects.

d) Assumes nonlocal state institutions had a 75 percent admissions cutoff.

e) In 1960 the typical city in Indiana had an extension campus with a 50 percent admissions cutoff and tuition of $199. This is compared to a California town with a free open-door community college but no four-year institution. Line 9 = 3 + 7 - 4.

f) Both were assumed to have had a local public four-year college, but Newark's tuition was $400 and the proportion of high-school graduates accepted was .45. While in California two-year tuition was zero and four-year tuition $65, and admissions policy was open door. Line 10 = 2 · line 4 - .325 line 5 + 7.

g) This estimate holds constant student ability but not characteristics of family such as SES, number of siblings, or number and recentness of school changes.

h) Draft pressure was the ratio of physicals passed to the stock of nonfathers under age 26 who were or would have been classified I-A, I-AC, I-S, or II-S. Its mean was 4.95 times the standard deviation.

lowers costs to a much greater degree ($471 in 1961 prices) and consequently causes a predicted rise in the attendance rate of .042.[10] Policies that affect travel, room, and board costs seem to have their largest effect on middle-income students.

For about 60 percent of our sample the cheapest college was a two-year institution. This however, does not prevent the cost of attending a four-year college from influencing the college entrance decisions of these people. To complete a four-year degree a student will have to attend a four-year institution for at least two years. Even for the first two years a student may prefer a more expensive four-year college to avoid the disruption of transferring, or because of the greater diversity of course offerings at a four-year college. The importance of these considerations is demonstrated by the fact that θ_3, the coefficient on the extra cost of a four-year college, is significantly negative in seven of the twenty strata. For every $200 by which the cost of the cheapest four-year college exceeds the cost of the cheapest two-year college, college entrance rates fell by .024 in the highest ability quartile and by .012 overall.

The Carnegie Commission has recommended that the tuition charged for junior and senior years be higher than the tuition charged for the first two years. Our results suggest that if such a policy were broadly implemented, freshman entrance rates would drop by .006 per $100 of such a tuition differential (line 5). Moreover, the establishment of a two-year college in a city that has no college does not increase the local college attendance rate as much as does the establishment of a four-year college with the same tuition level (compare line 2 to line 7 or 8).

Except for students from poverty backgrounds, admissions requirements also had substantial effects on attendance (line 6). If a state were to go from accepting half to accepting all of its high school graduates, the proportion entering college would rise by .038. As one might expect, the less able are quite sensitive to admissions policy; the proportion entering from the bottom-ability quartile would rise by .067. The breadth of curriculum at the cheapest college also had an important impact on college entrance (see line 3). When the cheapest college was a two-year extension campus without vocational programs, the proportion entering college was reduced by .046.

There is a substantial degree of variation across the country in the extent to which state policies promote college attendance. Lines 9 and 10 of Table 3 present our predictions of the enrollment response in 1961 if typical cities in Indiana and New Jersey had adopted California's package of higher education policies. Enrollment rates for some groups would have risen by almost 25 percentage points, and the overall attendance rates would have risen by 15 percentage points, and the rates for those in poverty families would have risen by 13 to 20 percentage points, or by about 70 to 100 percent.

Cultural and Economic Climate

The social status of the neighborhood in which the high school is located seems to have an important effect on college attendance. By a two-tail test, nine of the coefficients were significantly positive and three were significantly negative at the .05 level. Positive effects were strongest in the lowest-ability group. An improvement of one standard deviation in neighborhood status raised the overall proportion

entering college by .023 (see line 11). This result is similar to the effects estimated by Sewell and Armer [1966] and other sociologists. This is a large effect; per $1000 of real income it is nearly as large as the effect of the income of one's own family. Comparing the college nonattendance rates in the columns of Table 1, we obtain, per $1000 of real income a .027 change in probability as the approximate total effect of family income holding ability constant (line 12, Table 3). Competing with many additional variables, the point estimate for neighborhood effects is .016 per $1000.

Higher opportunity costs of student time have a generally negative effect on college entrance. The sign of its coefficient (θ_7) is negative in fifteen of the subgroups and significantly so in seven. Per dollar, however, the opportunity cost of student time has a much smaller effect on college attendance than does tuition and a somewhat smaller effect than costs of travel, room, and board. Averaged over the full sample tuition's impact is five times that of foregone earnings. This difference is significant at .01 level. The mean coefficient for travel, room, and board is 60 percent larger--a difference that is significant at the .05 level.

These smaller coefficients on foregone earnings were not a surprise. Theory had led us to expect them because higher local wage rates signal not only a higher real price of college attendance but also greater resources available for self-financing college attendance. Our sample of 1960 high school juniors did not have access to large loans at fixed interest rates. When loans are unavailable or insufficient, the student's ability to earn money by part-time and summer work will partially determine whether he attends college [Parsons, 1974]. The smaller coefficients on

foregone earnings can, therefore, be interpreted as evidence that in 1961 many students found the ability to finance college an important constraint on their decisions. The evidence is not conclusive, however, for other interpretations are possible. The smaller effect of foregone earnings could also mean that most students do not understand the concept of foregone earnings and, therefore, behave as if the opportunity cost of their time was either zero or unrelated to local wage rates.

The local college-high school earnings differential is a rather imperfect representation of the variable--the expected earnings payoff--suggested by theory. One might expect geographic variations in the expected earnings differential because an important source of information about this differential--direct observation of the wealthier life style associated with having been a college student--is local. Even if there were perfect knowledge, students preferring not to migrate would include the local differential in their calculation. The measure available for this study is the difference between median operative earnings and an average of medians for accountants, male secondary school teachers, and electrical and mechanical engineers in the SMSA of residence or in the non-SMSA portion of the state. Its impact on college attendance did not consistently follow a priori expectations (line 15). By a two-tail test, the coefficients were significantly negative in three strata and significantly positive in seven.[11] The groups with negative coefficients were the bottom-ability quartile and the strata that combine high ability and high income. Because members of the bottom-ability quartile are often excluded by admissions policies, costs and returns seemed to have only a small effect on them. The most important determinants of their attendance were admissions policy, neighborhood status, and draft pressure. The

absence of a positive effect for those who combined high ability and high income may reflect their greater tendency to migrate or to judge returns on the basis of national, as opposed to local, evidence.

Between 1968 and 1974 the income differential between college and high school graduates has fallen by a third. In our data a reduction of one-third in the local earnings differential ($1000 in 1960 prices) produced an overall drop in the college entrance rate of only .021. These very small impacts suggest, that either future returns are not known with any accuracy or are discounted at extremely high (> 50 percent) interest rates or that local variations in the return do not affect the formation of expectations about the payoff to college. If one accepts either of the first two explanations, the current decline in the return to college cannot be expected to cause a large reduction in enrollment.

In the early sixties the selective service system contended that "many young men would not have pursued higher education had there not been a Selective Service program of student deferment" [Hershey, 1961, p. 25]. The effectiveness of "channeling," as this policy objective was called, is supported by our results. Significant positive coefficients were obtained in nine of twenty strata. A rise of one standard deviation in draft pressure is predicted to increase attendance rates of high-income students by .032 and of all students by .015.

3. INTERPRETING THE PAST

Of what significance are our results for the interpretation of past enrollment trends and for the projection of future trends? Elements of our model have appeared in specific time series studies: tuition in

Campbell and Siegel, draft pressure in Galper and Dunn, relative wages in Freeman. None has entered all three simultaneously. The recent papers by Richard Freeman and Stephen Dresch have interpreted the rise of male college enrollment rates in the fifties and sixties and their subsequent decline in the seventies as responses to changes in the relative earnings of college graduates. In Freeman's paper, measures of public policy were not entered and a dummy for the end of the draft was insignificant. While the evidence is in no sense conclusive, our study points in another direction. In this cross-sectional analysis, differences in the local payoff to college had a negligible effect on attendance. The large impacts estimated for admissions policy and the establishment of new institutions suggest that an important part of the upward trend in enrollment rates during the fifties and sixties can be attributed to the establishment of two- and four-year public colleges in states and metropolitan areas where they had not previously existed, the expansion of student aid programs, and the liberalization of admissions policies resulting from the creation of community colleges. By 1970 the impact of these policies shifts may have largely run their course. The powerful impact of draft pressure estimated in the cross section suggests that the Vietnam War and subsequent ending of the draft caused a temporary rise in college enrollment rates between 1965 and 1969.

Unlike the market-driven models of Freeman and Dresch, this scenario also provides an explanation of the contrasting behavior of men over age 25. While the proportion of males aged 18-24 (civilian and military) attending college has remained static since 1965, enrollment rates of men aged 25 and over has risen dramatically. The continuing increases in adult male

enrollment rates are interpreted here as responses to the GI Bill and to the spread of community colleges [see Bishop and Van Dyk, 1975].

If the market-driven models of Freeman and Dresch are correct, the college graduate labor market will be brought into equilibrium largely by the supply response of students. If the more complete model proposed here is correct, most of the postwar rise in enrollment rates is due to trend improvements in the income and education of the population and reduction in real cost of college attendance.

This implies that a large supply response to the current depressed state of the college graduate labor market is not very likely unless the end of the shortage of college graduates induces a shift in public policy. The recent spectacular growth of the Basic Opportunity Grants program (1.7 billion dollars in 1976-1977) suggests that public financial support for undergraduate education will continue to increase. Consequently, relative wage-induced substitution of college graduate workers for others must carry most of the burden of equilibrating supply and demand of college graduates. If the view developed in this paper is correct, it should be good news for colleges because it means that enrollments will not decline as much as predicted by the models of Freeman and Dresch. For college graduates it is bad news, however, for it means that supply and demand will come into equilibrium at a lower relative wage. The relative importance of these alternative explanations of recent history is not yet clear, however.

The combination of a short time period, sampling errors in the college enrollment series, and collinearity among the independent variables prevents time series analysis of the postwar era from providing a strong test of the alternative scenarios. The unknown degree to which people

discount local variations in the return to schooling prevents this or any cross-section study from definitively estimating the likely impact of changes in the future payoff. The decomposition of recent changes in college enrollment rates requires a combination of the two approaches. What is needed is the construction of detailed indices of shifts in public policy over time, and the calculation of a predicted time series of enrollment rates based upon known changes over time in parental characteristics, number of siblings and public policy. The difference between actual and predicted enrollment rates would then be regressed on measures of draft pressure, cyclical unemployment, and relative wages.

Appendix

I. Data

The data base for this study is 27,046 males who were high school juniors in 1960 and for whom information was obtained in one of the two Project Talent follow-up efforts. Over 95 percent of our sample are in the Project Talent 5 percent stratified random sample of the nation's high schools, so the juniors originally contacted in 1960 are broadly representative of the total population of juniors [Flanagan et al., 1964]. The proportion of these juniors who responded to one of the questionnaires mailed in 1962 and 1966 was only 53 percent, however. More intensive follow-up procedures were used for a 5 percent sample of the mail questionnaire nonrespondents, and data was obtained for 90 percent of this sample of nonrespondents.

A comparison of the two samples reveals that responding to a mailed questionnaire is positively related to college attendance. Controlling for family background, the college attendance rate of the nonrespondent sample was two-thirds that of the respondents. Probability of responding to the mailed questionnaires is not solely a function of college attendance, however. Consequently, an unweighted logit model will yield biased estimates of many of the crucial parameters. Manski and Lerman [1976] have shown that the solution to this statistical problem is to give each observation in the intensive follow-up sample of mail questionnaires nonrespondents a weight of twenty. The computer program used was a modified version of "Maximum Likelihood Estimators for the Logistic Model with Dichotomous Dependent Variables" by T. Paul Schultz and Kenneth Maurer.

II. Selection of the College that Represents the College Availability Environment

The college used to represent a student's college availability was required to meet the following five conditions:

1. The college had to provide a broad range of programs. Therefore, Bible schools, seminaries, and business, engineering, and teachers' colleges were excluded.

2. The college had to admit men.

3. The college could not be so selective that it accepted less than 20 percent of the high-school graduating class of the state in which it was located.

4. A denominational college had to be of the same religion--Catholic, Jewish, or Protestant--as the student. There is a very strong tendency for students to avoid denominational colleges. As a result, in 1967 only 2.9 percent of the freshmen at Catholic colleges were Protestant and only 7.7 percent of the freshmen at Protestant colleges were Catholic.

5. In the South a college generally had to be of the same race as the student. The only exception to this was that if the number of black students at a predominantly white college was either greater than fifteen or a higher proportion of the student body than .10 times the black proportion of the state's population that college was considered biracial. By this very liberal criterion no white colleges were biracial in Alabama, Georgia, Mississippi, and South Carolina. There were one each in Arkansas and Florida, seven or eight in Louisiana and North Carolina, ten out of thirty-eight in Tennessee, and thirty-nine out of ninety in Texas.

Within the set of colleges defined by the above five conditions, the college that was assumed to be the "most attractive" was the one that was least costly to attend. Cost was defined to include travel and incremental room and board costs. A computer program was written that for 27,000 students in 1500 high schools selected from the pool of over 2000 possible colleges, the cheapest college meeting the five requirements described above. Use of the minimum-cost criterion is justified by the fact that the college that is least costly to attend is the one least likely to be impossible to finance. When financing the out-of-pocket costs is not a constraint, the cheapest college will still rank high by other criteria. For the 86 percent of the sample whose minimum cost college was within commuting distance, the mean distance to the college was 10.8 miles. The physical closeness of the college no doubt increased its salience. Trent and Medsker found that in towns with a junior college, almost three-quarters of those who went to college attended the local junior college (i.e., the minimum-cost college). Low cost and physical proximity need be dominant considerations for only some of the students, however, for many others will focus on the same college simply because that is where most of their friends are attending. Lower expected pecuniary and nonpecuniary benefits may in specific instances outweigh advantages of low cost, but for students near the margin on the decision to attend or not to attend this will happen only infrequently. If one of these students is admissible at the low-cost public colleges of a state, a lowering of those colleges' expenditures per student or a rise in tuition at higher-cost private colleges is not likely to dissuade the student altogether from attending college. Hopkins [1974] found that

when tuition and proximity were held constant, a states' college attendance rates were not related to per-student expenditures in the public and private colleges of that state.

This constrained selection of the cheapest form of college attendance usually results in a local public college representing the college availability environment. Using the approach described above, the primary determinants of the costs of college attendance turn out to be the level of instate tuition, the distance from the student's high school to the nearest public institution, and whether a student lives in a political jurisdiction with access to a low-tuition junior college.[1]

Except for a variable describing the extra costs of a four-year college, only the cheapest college's characteristics enter the model. If the data set and computing resources had been large enough, the characteristics of other colleges would have been added to the model. It is unlikely that the explanatory power of the model would have improved, however. In linear probability models where it was possible to try out larger numbers of variables, entering separately the characteristics of the cheapest two-year and four-year public and four-year private colleges did not raise the $\bar{R}^2$ above that obtained from a model that was limited to the characteristics of the minimum-cost college no matter what its type. If our parsimonious specification is incomplete and the characteristics of the second- and third-cheapest college do enter the true model, the coefficients obtained on the characteristics of the cheapest college will overestimate that college's unique effect but underestimate the total effect of simultaneous changes by all colleges.

Appendix Notes

[1]In 1961 many publicly supported institutions charged lower fees to students who applied from within the district that provided financial support. Schools of this type in 1961 were the municipal universities of Kansas, Kentucky, Ohio, Nebraska, and New York and public junior colleges in Arizona, Colorado, Florida, Idaho, Illinois, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Oregon, Texas, and Wyoming. In some states the in-out district price differential was small--$40 or so in Iowa--but in others, Illinois and Maryland for instance, it was between $200 and $300.

NOTES

[1]In 1961 only a few states had guaranteed loan programs, and the National Direct Student Loan program was new and generally awarded loans on the basis of financial need.

[2]The commuting cost of one college year was assumed to involve 4 1/2 trips per week for 32 weeks. Running costs of five cents a mile are assumed to be shared by two riders two-thirds of the time so the mean per person per mile cost is 3 1/3 cents per mile. Graduates from Project Talent high schools working full time averaged $1.25 an hour in 1961. Since studies of commuting typically find that travel time is valued at substantially below the average wage (Lave, 1970). We assume that the mean opportunity cost was $.75 an hour. Distance from the students' high school to a college was measured "as the crow flies" (except for a few explicit adjustments for tolls and necessarily roundabout routes). And an average 30 miles an hour was assumed. The first 3 or 5 miles of travel within cities of more than 100,000 population were assumed to cost twice as much per mile. For more detail see Bishop [1974].

[3]An early IQ measure would have been best but was not available. The test used was the Project Talent academic aptitude composite minus one of its subtests (a math information subtest focusing on the definitions of terms like quadratic and factorial that would only have been covered in college preparatory math courses).

[4]The alternative would be to estimate a full recursive model. Curriculum, achievement test scores, and grades would be predicted with variables describing the levels of tuition and minimum cost and the relationship between minimum cost and a student's credentials at the

end of his high school career. Attendance would then be predicted with the student's credentials and the characteristics of the cheapest college his credentials make him eligible for. Finally, the total effect of public policy would be obtained by summing the direct effects and the indirect effects through credentials.

[5]The policy-making process that determines college location, tuition, and admissions policy is assumed to be independent of the error term of our equation. This assumption has also been made by all previous researchers. It can be justified either by strict exogeneity (infinitely elastic supply curves) or counteracting influences that balance out on average.

[6]Entropy is a measure of the uncertainty of a probability distribution that is defined as minus the expectation of the logarithm of the probability. If the outcome being predicted has only two alternatives, the entropy ranges between 0 and $-\ln(.5) = .693$. According to Theil [1967], it is a better measure than R^2 of goodness of fit for categorical dependent variables.

[7]Because it is so sensitive to the mean of the variable and attendance rate, there is no reason to expect the elasticity of demand to be the same in different studies or in different samples.

[8]This is a consequence of Jensen's Inequality (Mood, Graybill, and Boes, p. 72). The "i"th individuals predicted probability $\hat{P}_i$ is a random variable with mean $\bar{P}$. Since the function $\hat{P}_i(1-\hat{P}_i)$ for $0 \leq \hat{P}_i \leq 1$ is concave, $\frac{\Sigma(\hat{P}_i(1-\hat{P}_i))}{M} \leq \bar{P}(1-\bar{P})$.

[9]The marginal subsidy cost (MSC) could alternatively be named the marginal profit lost. $MSC = \partial\Pi/\partial\bar{P} = MC - MR = (MC - MR = (MC-T) + (T-MR) = 9.00 + \bar{P}/(d\bar{P}/dX_1)$ in hundreds of dollars. It assumes that all public and private tuitions decline by an equal amount and that the additional students enter public institutions.

[10]The estimated model constrains all of the travel and incremental room and board costs of attending the least cost college to have equal per dollar impacts. Consequently, comparisons of policies that effect travel, room, and board costs in different ways primarily reflect the measurement assumptions made in constructing the variable. Linear probability models suggest that the effect of commuting distance is somewhat greater (about 50 percent) than the estimates tabulated in line 1.

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